CANDIDATE AND LISTING PRIORITY ASSIGNMENT FORM

SCIENTIFIC NAME: *Urocyon littoralis catalinae, Urocyon littoralis littoralis, Urocyon littoralis santacruzae,* and *Urocyon littoralis santarosae*

COMMON NAME: island fox

LEAD REGION: Region 1

INFORMATION CURRENT AS OF: September 2001

STATUS/ACTION (Check all that apply):
_X_ New candidate
___ Continuing candidate
    ___ Non-petitioned
    ___ Petitioned - Date petition received: ___
        ___ 90-day positive - FR date: ___
        ___ 12-month warranted but precluded - FR date: ___
    ___ Listing priority change
        Former LP: ___
        New LP: ___
___ Candidate removal: Former LP: ___ (Check only one reason)
    ___ A - Taxon more abundant or widespread than previously believed or not subject to a degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.
    ___ F - Range is no longer a U.S. territory.
    ___ M - Taxon mistakenly included in past notice of review.
    ___ N - Taxon may not meet the Act's definition of "species."
    ___ X - Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Family - Canidae
Order - Carnivora

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: California

CURRENT STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: California

LEAD REGION CONTACT (Name, phone number): TBD

LEAD FIELD OFFICE CONTACT (Office, name, phone number):
Ventura Fish and Wildlife Office
Bridget Fahey
(805) 644-1766

BIOLOGICAL INFORMATION (Describe habitat, historic vs. current range, historic vs. current population estimates (# populations, #individuals/population), etc.):

Taxonomy. The island fox was first described as *Vulpes littoralis* by Baird in 1857 from the type locality of San Miguel Island, Santa Barbara County, California. Merriam (1888, in Hall and Kelsey 1959) reclassified the island fox into the genus *Urocyon* and later described island foxes from Santa Catalina, San Clemente and Santa Cruz island as three separate species (*U. catalinae, U. clementae,* and *U. littoralis santacruzae*)(Merriam 1903). Grinnell *et al.* 1937 revised Merriam's classification, placing foxes from all islands under the species *U. littoralis* and assigning each island population a subspecific designation (*U. l. catalinae* on Santa Catalina Island, *U. l. clementae* on Clemente Island, *U. l. dickeyi* on San Nicolas Island, *U. l. littoralis* on San Miguel Island, *U. l. santacruzae* on Santa Cruz Island, and *U. l. santarosae* on Santa Rosa Island). Recent morphological and genetic studies support the division of the *U. littoralis* complex into six subspecies which are each limited in range to a single island (Gilbert *et al.* 1990, Wayne *et al.* 1991, Collins 1991a, 1993). Each subspecies is reproductively isolated from the others by a minimum of three miles of ocean waters. The island fox is closely related to the mainland gray fox, *U. cinereoargenteus*, but is smaller in size and darker in coloration (Moore and Collins 1995).

Distribution and abundance. Island foxes inhabit the six largest islands (San Miguel, Santa Rosa, Santa Cruz, San Nicolas, Santa Catalina, and San Clemente islands) off the coast of southern California. Genetic evidence suggests that all island foxes are descended from one colonization event (George and Wayne 1991), possibly from chance overwater dispersal by rafting on floating debris (Moore and Collins 1995). Fossil evidence indicates that island foxes have been on the northern Channel Islands (San Miguel, Santa Rosa, and Santa Cruz) for over 10,000 to 16,000 years (Orr 1968). Island foxes are thought to have existed on the northern Channel Islands during a period when Santa Cruz, Santa Rosa and San Miguel were one land mass referred to as "Santarosae", last known to have been united 18,000 years before present (Johnson 1978, 1983). The island fox were thought to have reached the southern Channel Islands (San Nicolas, San Clemente, and Santa Catalina) much more recently (2,200 to 3,800 years ago), most likely introduced to these islands by Native Americans as pets or semi-domesticates (Collins 1991a,b). However, island fox remains recently recovered from San Nicolas Island extend this time period to approximately 5,200 years before present (Vellanoweth 1998).

In the 1970s, island foxes were found to exist at higher densities than any other canid species, likely due to the lack of competition and predation compared with the island foxes' mainland canid counterparts (Laughrin 1980). At the time of Laughrin's early studies, island fox populations were stable on all islands except Santa Catalina (Laughrin 1973).

Four of the six island fox subspecies have experienced precipitous decline in the last four years: San Miguel Island fox, Santa Rosa Island fox, Santa Cruz Island fox, and Santa Catalina Island fox (Coonan *et al.* 1998; 2000; and in review; Roemer 1999; Timm *et al.* 2000; Roemer *et al.* in

prep b). Total island fox numbers have fallen from approximately 6000 individuals (Roemer *et al.* 1994) to less than 2000. Island fox populations on San Miguel and Santa Cruz islands have declined by an estimated 80 to 90 percent and have a 50 percent chance of extinction over the next 5 to 10 years (Roemer 1999, Roemer *et al.* in prep b). Long-term island fox population monitoring has not been undertaken on Santa Rosa Island; however, anecdotal observations and limited trapping efforts strongly suggest that a similar decline has occurred for this subspecies as well (Tim Coonan, wildlife biologist, Channel Islands National Park, pers. comm. 1999; Gary Roemer, University of California at Los Angeles, pers. comm. 1999). Island fox populations on the northern Channel Islands are considered to be critically endangered and in need of immediate conservation action (Coonan *et al.* 1998, Roemer 1999). On Santa Catalina, island foxes are now rare on the larger eastern portion of the island. This decline is thought to be a result of a canine distemper outbreak that swept through the population in 1999 (Timm *et al.* 2000). Populations of the San Clemente and San Nicolas island fox appear to be stable. However, fox populations on San Clemente and San Nicolas islands should continue to be monitored to determine if these two subspecies should be considered for future inclusion as candidate species.

San Miguel Island. The first quantitative surveys for island foxes on San Miguel Island were conducted by Laughrin in the early 1970s (Laughrin 1973). Trap efficiency was high (43 percent) and Laughrin concluded that island fox populations were stable at 7 foxes per square mile, although this may be an underestimate. In the late 1970s, the island foxes on San Miguel had an average density of 12 foxes per square mile for a total estimated population of 151 to 498 individuals (Collins and Laughrin 1979). Island foxes on San Miguel Island were not surveyed again until the National Park Service (NPS) instituted a long-term population study in 1993 which recorded an average density of 20 foxes per square mile and estimated the total population at more than 300 foxes (Roemer *et al.* 1994, Coonan *et al.* 1998). A trapping survey done the following year resulted in the highest island fox densities ever recorded (41 foxes per mile in one study area) and a larger island-wide estimate of 450 adults (Coonan *et al.* 1998). The cause for the increase in population size from 1993 to 1994 is not known. Annual population monitoring using capture-mark-recapture techniques documented a substantial decline in island fox populations on San Miguel Island between 1994 and 1999 (Coonan *et al.* 1998, Coonan *et al.* in review). In the last six years, estimated population size dropped from as many as 450 adults in 1994 (Coonan *et al.* 1998) to 15 adults currently (Coonan *et al.* in review). NPS has captured 14 individuals (4 males and 10 females) of this population to protect them from further losses to predation and to initiate a captive propagation program. The only known individual in the wild on San Miguel is a lone radio-tagged female (Coonan *et al.* in review). One pair of foxes produced a successful litter of two pups in the spring of 2000. The captive San Miguel Island fox population may be impacted by high parasite loads (Linda Munson, University of California at Davis, unpublished data).

Santa Rosa Island. The earliest island fox trapping study from Santa Rosa reported a trapping efficiency of 50 percent and a density of 11 foxes per square mile (Laughrin 1973). Few population data have been collected on Santa Rosa island foxes since Laughrin's studies.

However, anecdotal evidence suggests that Santa Rosa has experienced a decline similar to those on Santa Cruz and San Miguel islands (G. Roemer pers. comm. 1999). During 130 trap nights in 1998 only nine individuals were captured for a trap success rate of 4.8 percent (G. Roemer and D. K. Garcelon, unpublished data). Anecdotal sightings by park and ranch staff are much less frequent than in previous years. Less than 100 island foxes are thought to remain on Santa Rosa Island (T. Coonan pers. comm. 1999). Of these, ten (four males and six females) were brought in to a captive breeding facility in March 2000. Three pairs of foxes produced a combined total of eight pups in this facility in 2000 (T. Coonan pers. comm. 2000).

Santa Cruz Island. Santa Cruz Island is the largest of the Channel Islands and has supported the highest known densities of island fox in the past (Laughrin 1973). Laughrin (1971) estimated the island fox population of Santa Cruz island to be approximately 3000 individuals. Average density between 1973 and 1977 was 20.4 foxes per square mile (Laughrin 1980). Following Laughrin's studies, island fox populations on Santa Cruz Island were not surveyed again until 1993. Since that time, the population has decreased from a high of 1,312 in 1993 to its current estimated size of 133 (Roemer 1999, Roemer *et al.* 1994, G. Roemer pers. comm. 2000a). In 1998, island fox density ranged from 0.0 to 6.2 foxes per square mile, the lowest reported from Santa Cruz Island (Roemer 1999).

Santa Catalina Island. Santa Catalina Island has a large human population and the highest degree of activity and accessability of the Channel Islands (Laughrin 1973). Island fox numbers on Santa Catalina Island have fluctuated widely over the past 30 years. In Laughrin's early 1970s studies, only two island foxes were trapped on Santa Catalina Island for a trap efficiency of six percent and an average density of 0.3 foxes per square mile (Laughrin 1973). This density was 37 percent lower than any other island during this study. The reason for past low island fox numbers on Santa Catalina Island is unknown, as the island had comparable food and habitat availability to other islands. Island fox numbers on Santa Catalina Island increased slightly between 1975 and 1977 with average densities of 0.77 (Propst 1975) and 0.8 (Laughrin 1980) foxes per square mile. Between 1988 and 1991, average density increased, ranging from 6.7 to 33.1 foxes per square mile (Garcelon *et al.* 1991). The Santa Catalina Island fox population increased to an estimated 1342 foxes by 1994 (Roemer *et al.* 1994). However, Santa Catalina Island foxes have experienced a recent dramatic decline, thought to be due to the introduction of canine distemper to the island fox population on the eastern portion of the island (Timm *et al.* 2000). Santa Catalina Island is separated into a large eastern side and a small western side by a narrow isthmus. Trap success on the eastern side dropped from 26 percent in 1998 to 0.96 percent in 1999 and 2000, while remaining stable at approximately 36 percent on the western portion. Two live and one deceased island foxes recovered from the eastern portion of the island tested positive for canine distemper virus, constituting the first positive record of canine distemper in island foxes (Timm *et al.* 2000). A captive propagation program for the Santa Catalina Island fox is currently underway.

Description. The island fox is a diminutive canid, weighing approximately 3 to 6 pounds and standing approximately one foot tall. Dorsal coloration is grayish-white and black. The base of

the ears and sides of the neck and limbs are cinnamon-rufous in color. The underbelly is a dull white. Males are larger than females (Moore and Collins 1995).

Biology. This diminutive canid is the largest native carnivore on the Channel Islands. The island fox is a habitat generalist, occurring in all natural habitats on the islands (grasslands, coastal sage scrub, chaparral, and woodlands), although it prefers areas of diverse topography and vegetation (Von Bloeker 1967, Laughrin 1977, Moore and Collins 1995). Woodland habitats support higher densities of island fox due to increased food availability (Laughrin 1973, 1980). Island foxes are opportunistic omnivores, taking a wide variety of seasonally available plants and animals (Collins and Laughrin 1979, Collins 1980, Kovach and Dow 1981, Moore and Collins 1995). On San Miguel Island, sea fig (*Carpobrotus aequilaterus*), devastating grasshoppers (*Melanoplus devastator*), Jerusalem crickets (*Stenopelmatus fuscus*), deer mice (*Peromyscus maniculatus*), and ground-nesting birds such as horned larks (*Eremophila alpestris*) and western meadowlarks (*Sturnella neglecta*) make up the majority of the diet (Collins and Laughrin 1979, Collins 1980). Less common in the diet were amphibians, reptiles, and carrion of marine mammals (Collins and Laughrin 1979).

The island fox is a docile canid, exhibiting little fear of humans in many instances. Although primarily nocturnal, the island fox is more diurnal than the mainland gray fox (Collins and Laughrin 1979, Fausett 1993). This is thought to be a result from the historical absence of large predators and freedom from human harassment that occurred on the islands (Laughrin 1977).

Island foxes are distributed as mated pairs with highly overlapping territories that are separate from the territories of other pairs (Crooks and Van Vuren 1996, Roemer *et al.* in prep a). Home ranges sizes of island foxes vary with sex and season (Laughrin 1977, Crooks and Van Vuren 1996). Although island foxes appear monogamous, extra-pair fertilizations are actually common (Roemer *et al.* in prep a). Courtship activities occur from late January to early March. Young are born from late April through May after a gestation period of approximately 50 days. Island foxes give birth to their young in simple dens, which are usually not excavated by the foxes themselves. Litter size ranges from one to five (mean = 2.17). Island foxes exhibit biparental care (Garcelon *et al.* 1999). By two months of age, young spend most of the day outside the den and will remain with their parents throughout the summer. Island foxes will mate at the end of their first year (Collins and Laughrin 1979).

Due to the low reproductive output of island foxes, survival of adults is the most important factor determining population size (Roemer *et al.* 1994, Roemer 1999). Compared with the gray fox, island fox populations are skewed toward older adults (Laughrin 1980, Garcelon 1988). Adult island foxes live an average of four to six years (Moore and Collins 1995), although this may be an underestimate (Coonan *et al.* 1998).

THREATS (Describe threats in terms of the five factors in section 4 of the ESA providing specific, substantive information.

A. The present or threatened destruction, modification, or curtailment of its habitat or range. Habitat on all islands occupied by island foxes has been heavily affected by livestock grazing, cultivation, and other disturbance. A century and a half of overgrazing by non-native herbivores (sheep, goats, rabbits, deer, elk, cattle, pigs, and horses) has resulted in substantial impacts to the soils, topography, and vegetation of the islands (Johnson 1980, Coblentz 1980, Peart *et al.* 1994, O'Malley *et al.* 1994). One result of overgrazing has been the replacement of much of the native coastal sage scrub, chaparral, and oak woodland habitats with other vegetation, especially non-native annual grasses (Brumbaugh 1980, Klinger *et al.* 1994). Annual grasslands constitute less preferred habitat for island foxes (Laughrin 1977) and do not provide cover from predators such as golden eagles (Roemer *et al.* in prep b). The California Department of Fish and Game (CDFG), in recommending the retention of the island foxes classification as threatened under state law, cited the continued habitat degradation from herbivorous mammals on Santa Rosa, Santa Cruz, Santa Catalina, and San Clemente islands (CDFG 1987). Since that time, species removal programs have eradicated or reduced the introduced herbivore populations on many islands, but pigs, deer, elk, horses, or goats still remain on Santa Cruz, Santa Rosa, and Santa Catalina islands.

Even after the removal of non-native grazers on some islands, habitat recovery is slow and threatened by the spread of non-native plants that were able to gain a foothold during the ranching era. These exotic species continue to invade and modify island fox habitat resulting in lower vegetative diversity, less diverse habitat structure, and reduced food availability.

The Navy is currently preparing an environmental impact statement to develop and expand military training programs on San Clemente Island. It is unknown at this time what the preferred alternative will be and how this alternative could affect island foxes. Training activities on the Shore Bombardment Area of the south end of the island have caused increased occurrences of wildfires on the island; however, the Navy has implemented several measures to control these wildlifes. An increase in use of this area may result in more impacts to the San Clemente island fox habitat from wildfires, potentially affecting food availability or resulting in the death of individual foxes (especially pups during the denning season).

B. Overutilization for commercial, recreational, scientific, or educational purposes. Although island foxes were used in the past for pelts and ceremonial uses by Native Americans (Collins 1991b), island foxes are not currently known to be exploited for commercial, recreational, scientific, or educational purposes.

C. Disease or predation. Recent island fox declines on San Miguel, Santa Cruz, and Santa Rosa islands have been attributed to predation by golden eagles (*Aquila chrysaetos*)(Roemer 1999, Coonan *et al.* in review, Roemer *et al.* in prep b). Roemer (1999) linked 19 of 21 island fox mortalities on Santa Cruz Island between April 1994 to July 1997 to golden eagles. On San Miguel Island, 4 of 6 mortalities of radio-collared foxes were attributed to golden eagle predation during this same time period (Coonan *et al.* in review).

The current level of golden eagle activity on the northern Channel Islands is historically unprecedented (Paul Collins, Santa Barbara Museum of Natural History, unpublished data). Golden eagles were known to occasionally visit the islands but never to establish residence (Diamond and Jones 1980; Jones and Collins in prep.). The first known active golden eagle nest from the Channel Islands was located on Santa Cruz Island in 1999 (Brian Latta, Santa Cruz Predatory Bird Research Group, pers. comm. 1999; G. Roemer pers. comm. 1999). Island fox remains along with the remains of feral piglets *(Sus scrofa*), ravens (*Corvus corax*) and various seabirds were found in the nest. In September 1999, surveys by the Santa Cruz Predatory Bird Research Group identified twelve resident golden eagles with the possibility of five breeding pairs on Santa Cruz Island. Santa Cruz Island is the main nesting and roosting location for golden eagles on the northern Channel Islands, although one pair of golden eagles are likely nesting on Santa Rosa Island (B. Latta pers. comm. 2000). Golden eagles breeding on Santa Cruz Island are thought to "commute" to Santa Rosa and San Miguel islands to feed, where eagles have fewer alternative prey species to island foxes (i.e., no feral pigs as on Santa Cruz Island) and foxes have less vegetative to hide them from avian predators (Roemer *et al.* in prep b). To date, thirteen golden eagles have been captured from Santa Cruz Island and relocated to northern California to reduce further island fox mortality. An estimated seven golden eagles still remain on the northern Channel Islands, five on Santa Cruz Island and two on Santa Rosa Island (Brian Walton, Santa Cruz Predatory Bird Research Group, pers. comm. 2000).

Before the golden eagles started utilizing the northern Channel Islands in the 1990s, the only known predator of island foxes was the red-tailed hawk (*Buteo jamaicensis*), which only preyed on young island foxes (Laughrin 1973, Moore and Collins 1995). The docile and inquisitive nature of the island fox (Laughrin 1997) suggests an evolutionary history lacking predation (Carlquist 1974).

The recent colonization of the northern Channel Islands by golden eagles is likely a combination of two factors: 1) introduction of exotic mammals on the northern Channel Islands constituting an historically unprecedented prey base, and 2) the recent absence from bald eagles (*Haliaeetus leucocephalus*) from the islands as a result of DDT poisoning. Historically, the depauperate vertebrate island fauna would have provided little prey for golden eagles, which rely on a diet of small terrestrial vertebrates. Before the ranching era, transient golden eagles landing on the islands would have little prey to encourage them to establish permanent residence. Furthermore, nesting bald eagles would have discouraged foraging golden eagles from establishing residence by aggressively defending their already established territories. Bald eagles are represented in the prehistoric fossil record of the northern Channel Islands (Guthrie 1993) and bred there until 1960 when nest failures as a result of DDT contamination extirpated them from the northern Channel Islands (Kiff 1980).

Roemer *et al.* (in prep b) modeled time-energy budgets and predation rates of golden eagles on Santa Cruz island to determine if the precipitous decline in island foxes could be attributed to predation alone. Their model showed that in the presence of a large pig population, a population leveling off at seven eagles could cause the extinction of the Santa Cruz Island fox population in

11.5 years. This predicted time to extinction assumes that eagles prefer pigs to foxes three to one.

Disease. On Santa Catalina Island, the large sudden decline in island foxes has been attributed to canine distemper, most likely brought to the island by a domestic dog (Timm *et al.* 2000). The steep and sudden pattern of decline on Santa Catalina Island is more indicative of a disease outbreak rather than the slower decline due to predation seen on the northern Channel Islands (Timm *et al.* 2000). The evidence suggestive of a disease-related decline versus other causes are: 1) the population decline on Santa Catalina Island is of a similar magnitude (90 percent) as on the northern Channel Islands, but has occurred within one year rather than the steady 6-year decline seen on San Miguel, Santa Cruz, and Santa Rosa islands; 2) the declines on the northern islands are island-wide, while the geographically restricted western population on Santa Catalina Island have remained healthy; and 3) sick foxes have been seen on Santa Catalina Island but not on the northern Islands (G. Roemer pers. comm. 2000c).

Two healthy adult foxes caught on the east end of Santa Catalina Island in 1999 tested positive for canine distemper, constituting the first positive records of canine distemper in island fox . A necropsy of one island fox identified the cause of death as canine distemper (Timm *et al.* 2000). No island foxes tested positive for canine distemper in a previous comprehensive serologic survey of all islands. The absence of antibodies to canine distemper virus in any island foxes during this study implied that either the virus had never been introduced to the islands, or the species is highly susceptible to the virus and none survive infection. As the closely related mainland gray fox is highly susceptible to canine distemper virus, island foxes likely have high susceptibility as well (Garcelon *et al.* 1992).

All island fox populations have been surveyed for other canine diseases and parasites. Although island foxes are known to carry antibodies for a variety of canine diseases, none of these could explain the type or geographic distribution of the observed decline on the northern Channel Islands (Garcelon *et al.* 1992, Coonan *et al.* 2000, Roemer 1999, Roemer *et al.* in prep b). The most common antibodies found in island foxes are canine adenovirus and canine parvovirus (Garcelon *et al.* 1992). Canine herpesvirus, coronavirus, leptospirosis and toxoplasmosis have been recorded at low levels (Garcelon *et al.* 1992). Seroprevalence to canine adenovirus was similar before and after the population crashes on these islands, while antibodies for parvovirus were detected from a small number of samples from 1994, but not detected in 1995 or 1997 samples (Coonan *et al.* 2000).

Canine heartworm (*Dirofilaria immitis*) has been documented in four of the six island fox subspecies (*U. l. littoralis, U. l. santacruzae, U. l. santarosae,* and *U. l. dickeyi*; Roemer *et al.* in press). Despite the high seroprevalence of heartworm in these populations (between 58 and 100 percent in 1997-98) heartworm is not thought to be responsible for the decline of island foxes for the following reasons: 1) seroprevalence on San Nicolas Island, where the population is stable, is higher than on Santa Cruz Island, where the population is decreasing (Roemer *et al.* in press), 2) heartworm was present in all four subspecies in or before 1988, pre-dating the population

declines, 3) seroprevalence in the San Miguel population was high in 1994, when densities on that island reached the highest levels ever recorded for island foxes, and 4) necropsy results have found few adults worms in the hearts of island foxes and no evidence of heartworm disease (Roemer 1999). However, heartworm may have contributed to mortality in older foxes (Roemer *et al.* in press), exacerbating the conservation crisis for the island fox.

D. The inadequacy of existing regulatory mechanisms. The primary causes of the decline of the island fox are the degradation of habitat by introduced herbivores, unprecedented predation by golden eagles, and the rapid transmission of canine distemper through the Santa Catalina subspecies. Federal, State and local laws have not been sufficient to prevent past and ongoing losses of island foxes.

In 1971, the state of California listed the island fox as state-rare (a designation later changed to threatened), which means that it may not be taken without a special (i.e., scientific collecting) permit (CRC, Title 14, Section 41). However, this protection applies only to actual possession or intentional killing of individual animals, and affords no protection to habitat. State law does not require Federal agencies to avoid or compensate for impacts to the island fox and its habitat. There are currently no regulatory mechanisms designed for the protection of island foxes on the four islands that are Federally managed.

Several Federal laws apply to the management of National Park Service (NPS) and Department of the Navy (Navy) lands. These laws and guidelines include the National Environmental Policy Act (NEPA) and the Endangered Species Act. NPS management is further dictated by Department of the Interior policies and National Park Service policies and guidelines, including NPS guidelines for natural resources management (NPS 1991), the Channel Islands National Park Management Plan (NPS 1985), and the National Park Service Organic Act (16 U.S.C. 1 2 3, and 4). Both NPS and the Navy have adequate authority to manage the land and activities under their administration to benefit the welfare of the island fox. Steps are being taken to control feral cats on San Clemente and San Nicolas islands and decrease predation by relocating golden eagles from the northern Channel Islands. However, in some cases because of conflicting management concerns, other priorities and lack of funding, conservation efforts are not proceeding as quickly as necessary. In addition to removing golden eagles, their prey base must be removed to prevent them from recolonizing the islands. Santa Cruz Island is currently occupied by a large feral pig population (estimated at approximately 5000 individuals). The Nature Conservancy and NPS are planning an island-wide pig eradication program; however, the funding for this project is uncertain and may take several years to secure.

San Miguel Island is under the jurisdiction of the Navy, but NPS assists in the management of natural, historic, and scientific values of San Miguel Island through a Memorandum of Agreement (MOA) originally signed in 1963, an amendment signed in 1976, and a supplemental Interagency Agreement (IA) signed in 1985. The MOA states that the "paramount use of the islands and their environs shall be for the purpose of a missile test range, and all activities conducted by or in behalf of the Department of the Interior on such islands, shall recognize the

priority of such use" (Department of the Navy 1963). In addition to San Miguel Island, Santa Cruz and Santa Rosa lie wholly within the Navy's Pacific Missile Test Center (PMTC) Sea Test Range. The 1985 IA provides for PMTC to have access and use of portions of those islands, for expeditious processing of any necessary permits by NPS, and for mitigation of damage of park resources from any such activity (Department of the Navy 1985). Should the Navy no longer require use of the islands, NPS would seek authorization for the islands to be preserved and protected as units within the NPS system (Department of the Navy 1976). To date, conflicts concerning protection of sensitive resources on San Miguel Island have not occurred. However, if the Navy were to resume use of San Miguel Island, there are no mechanisms in place to protect the island fox.

On islands managed by Federal agencies, prohibitions against bringing domestic pets to the islands exist. However, these prohibitions are difficult to enforce and violations are known to occur. Boaters have been observed bringing pets onshore to all three northern Channel Islands with island fox populations. On Santa Catalina Island, health certificates or quarantines are not necessary to bring domestic pets to the islands, exposing island foxes to increased risk of disease.

Federal protection of golden eagles by the Bald and Golden Eagle Protection Act of 1962, as amended, has increased the golden eagle population on mainland California (B. Walton pers. comm. 2000). This population expansion has encouraged golden eagles to expand their range in order to establish breeding territories. The protections warranted to golden eagle limit management alternatives to protect island foxes.

California state law (Food and Agricultural Code 31752.5) prohibits lethal control of feral cats unless cats are held for a minimum of six days. This law prevent the Catalina Island Conservancy from taking steps to eradicate feral cats on the island, as it does not have adequate facilities to hold cats.

E. Other natural or manmade factors affecting its continued existence. Several other factors, including competition from introduced species, and stochastic environmental factors may have negative effects on island foxes and their habitats.

Competition with feral cats. CDFG, in recommending the retention of the threatened classification of the island fox under state law, cited the presence of competition with feral cats on Santa Catalina, San Nicolas, and San Clemente islands (CDFG 1987). The effects of cats on island foxes is unclear and may be fluctuate between islands and conditions. Island fox populations decreases on San Nicolas island were accompanied by a concomitant increase in feral cat populations (Laughrin 1978). Feral cats outweigh island fox by an average of 2:1 and may negatively affect island foxes by direct aggression, predation on young, disease transmission, and competition for food resources (Laughrin 1978). Feral cats have been found to displace island foxes from habitats on San Nicolas Island (Kovach and Dow 1985). San Nicolas and San Clemente island managers plan to continue or resume feral cat control programs, but

feral cats are extremely difficult to eradicate, requiring ongoing yearly programs to keep numbers controlled (Phillips and Schmidt 1997). No feral cat control exists on Santa Catalina island due to resistance to lethal control from the residents of the island and local ordinances.

Lack of genetic variability. As a population becomes genetically homogenous, its susceptibility to disease, parasites, and extinction increases (O'Brien and Evermann 1988) as its ability to evolve and adapt to environmental change is diminished (Templeton 1994). The four island fox subspecies that have suffered large declines could be at risk of having a reduced genetic variability due to the bottleneck in their population that has occurred, although no genetic testing has been done to verify this. However, the San Nicolas Island fox subspecies has been found to have an unusually low degree of genetic variability (Gilbert *et al.* 1990, Wayne *et al.* 1991, Goldstein *et al.* 1999). The average percent difference in DNA fingerprints of San Nicolas Island foxes was 0.0 percent, most likely a result of a major bottleneck at some point in time (Gilbert *et al.* 1990). Although the San Nicolas Island subspecies of island fox continues to exist at high densities, the precipitous declines seen on other islands coupled with the extremely low genetic variability puts this subspecies at high risk.

Stochastic environmental factors. Reduced population size exposes the island fox to stochastic events such as drought or wildfires that could cause or hasten extinction. The extremely small island fox population sizes on San Miguel, Santa Rosa and Santa Cruz islands puts those populations at extremely high extinction risk. For example, of the fourteen island foxes currently in the captive propagation program on San Miguel Island, only four are male. This skewed sex ratio may reduces the recovery ability of the species because island foxes typically form long-standing pair bonds and unpaired females have never been recorded to raise a litter. Because the island fox is distributed on small islands it is more subject to the effects of environmental perturbations and decline of birth rates due to low densities (i.e., Allee effects)(Allee 1931) than species occurring on the mainland. Island endemic species have high extinction risk due to isolation and small population sizes (MacArthur and Wilson 1967).

Road mortalities. The fearless nature of island foxes coupled with relatively high vehicle traffic on the southern Channel Islands results in a number of vehicle collisions each year. Death by collision with vehicles is the largest known source of mortality on San Nicolas and San Clemente islands, taking approximately 30 foxes on San Nicolas per year (G. Smith pers. comm. 1999) and 26 foxes between the years 1991 and 1995 on San Clemente Island (Garcelon 1999). Vehicle collisions likely cause a comparable number of deaths on Santa Catalina Island, although no records are kept. Vehicle collisions on the northern Channel Islands are uncommon due to low traffic and the rough unpaved nature of most roads.

LAND OWNERSHIP (Estimate proportion Federal/state/local government/private, identify non-private owners):

All islands:

Federal Ownership - 56% (NPS and DOD)
Nonprofit (Private) Ownership - 41% (The Nature Conservancy and The Catalina Island Conservancy)
Other Private - 3%

San Miguel Island
Federal Ownership - 100% (owned by DOD, managed by NPS)

Santa Rosa Island
Federal Ownership - 100% (NPS)

Santa Cruz Island
Federal Ownership - 20% (NPS)
Nonprofit (Private) Ownership - 80% (TNC)

San Nicolas Island
Federal Ownership - 100% (DOD)

San Clemente Island
Federal Ownership - 100% (DOD)

Santa Catalina Island
Nonprofit (Private) Ownership - 88% (Catalina Island Conservancy)
Other Private Ownership - 12%

PRELISTING (Describe status of conservation agreements or other conservation activities): Participation in conservation action team meetings held by NPS in 1999 and 2000. The Service has initiated the development of a candidate conservation agreement with the Navy for the San Clemente Island fox.

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LISTING PRIORITY (place * after number)

THREAT			
Magnitude	Immediacy	Taxonomy	Priority
High	Imminent	Monotypic genus	1
		Species	2
		Subspecies/population	3*
	Non-imminent	Monotypic genus	4
		Species	5
		Subspecies/population	6
Moderate to Low	Imminent	Monotypic genus	7
		Species	8
		Subspecies/population	9
	Non-imminent	Monotypic genus	10
		Species	11
		Subspecies/population	12

APPROVAL/CONCURRENCE: Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes to the candidate list, including listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all additions of species to the candidate list, removal of candidates, and listing priority changes.

Approve: John Engbring _____ 10-12-2001
Acting Manager, California/Nevada Operations Office, Fish and Wildlife Service — Date

Concur: Marshall P. Jones, Jr. _____ October 17, 2001
Acting Director, Fish and Wildlife Service — Date

Do not concur: _____ _____
Director, Fish and Wildlife Service — Date

Director's Remarks: _____

_____

(rev.7/98)